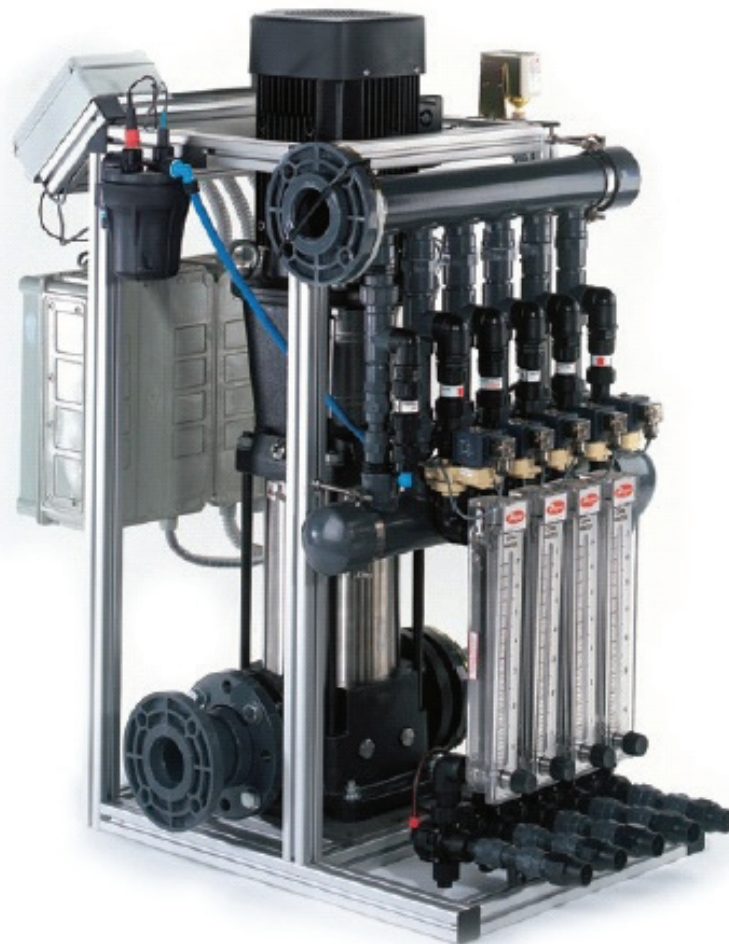


Fertijet

User's Manual



Fertijet – enhanced fertigation machine

User manual

1. General Description

Fertijet is a compact, simple and modular fertigation control system for use in both greenhouses and open field irrigation applications.

Fertijet is designed for accurate injection of nutrients into the irrigation water pipe through a set of Venturi type fertilizer injectors under EC & pH control and optional irrigation control by the advanced Elgal computerized controller.

Fertijet can be fitted quickly and easily on almost any irrigation head.

1.1 System Components

A standard Fertijet unit consists of the following components:

- A set of 3 Venturi type fertilizer injectors with a flow rate of up to 90 GPH each. Each injector contains an electric fertilizer control valve, an adjustable flow regulator, and a flexible suction pipe.
- A water pump (1.5, 2.5 or 3 H.P.) with a stainless steel head, to obtain a flow of water through the fertilizer injectors and insert the solution into the water pipeline.
- An EC & pH monitor unit, consisting of a transmitter with a 4-20 mA output, galvanic insulation, a large LCD display and a four-button keyboard for soft calibration.
- A pair of EC & pH electrodes, installed in a sampling cell.
- An Elgal irrigation/ fertigation controller.
- An electrical control panel, also including connection terminal blocks.
- An inlet and an outlet for irrigation water.



1.2 Safety Instructions

- Before installing and connecting the Fertijet in place, read the “Pre- Installation” manual carefully and follow all the instructions applicable to Fertijet.
- To install the Fertijet and associated equipment, follow NFPA 70 directives strictly.
- Have high voltage (> 60V) electrical connections made only by a local, qualified electrician.
- Do not operate the Fertijet before ensuring full connection to a valid grounding point (1Ω or lower).
- Before removing the electrical box cover, shut the main power switch Off.
- Before attempting any maintenance work on the booster pump, shut the main power switch Off.

- Since Fertijet is designed to inject dissolved chemicals, some of which are dangerous in contact or inhalation, use protecting glasses, rubber gloves and gas mask as required.
- Before attempting any maintenance work on the injectors, close all manual valves at the fertilizer tank outlet
- Follow all local regulation as applicable to storage and handling of chemicals.
- Before attempting to remove or install the water piping system, depressurize all main pipes.

2. Installation and Connection

2.1 Plumbing

Applications

Four types of applications are available:

- a. Typical: Mainline not pressurized while the Fertijet is off.
Mainline pressure ≤ 70 PSI.
- b. Non- driven: Mainline optionally pressurized while the Fertijet is off.
Mainline pressure ≤ 70 PSI.
- c. High pressure: Mainline not pressurized while the Fertijet is off.
Mainline pressure ≥ 70 PSI.
- d. HP Non- driven: Mainline optionally pressurized while the Fertijet is off.
Mainline pressure ≥ 70 PSI.

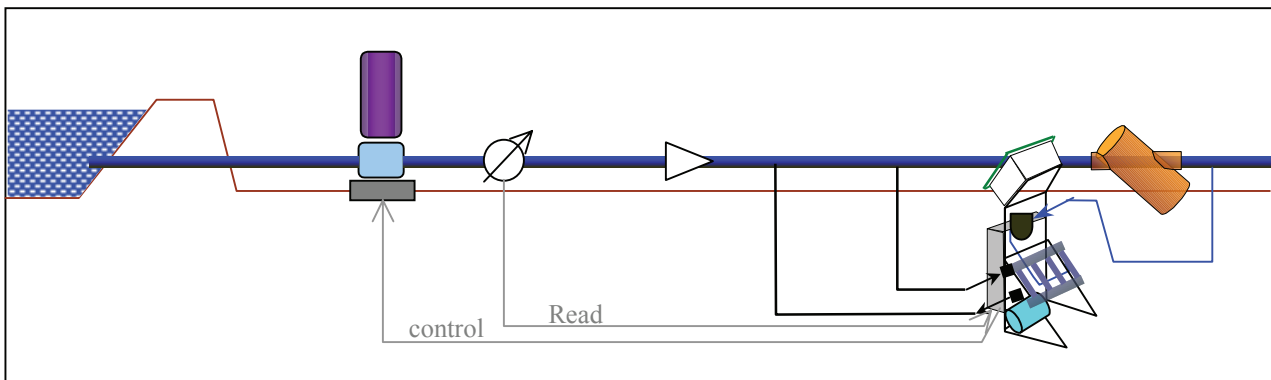


Figure 1: Typical Installation

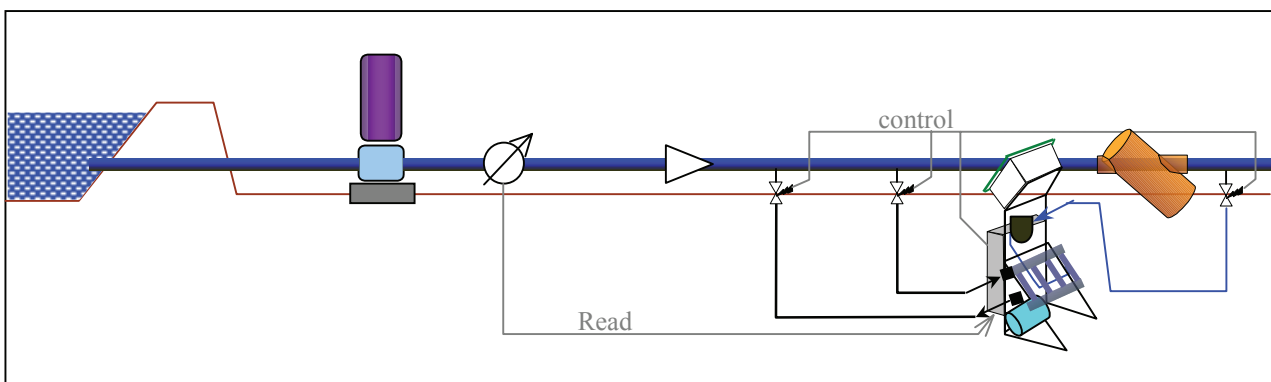


Figure 2: Non-Driven

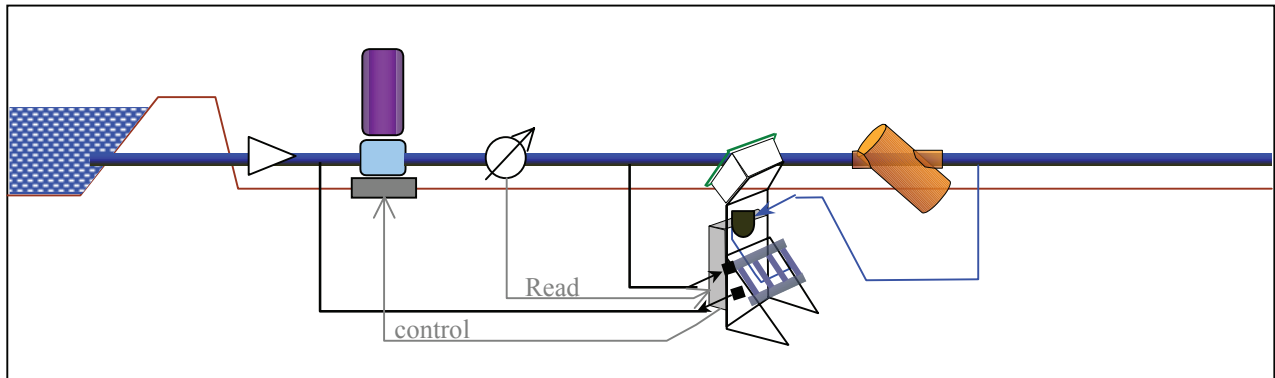


Figure 3: High Pressure

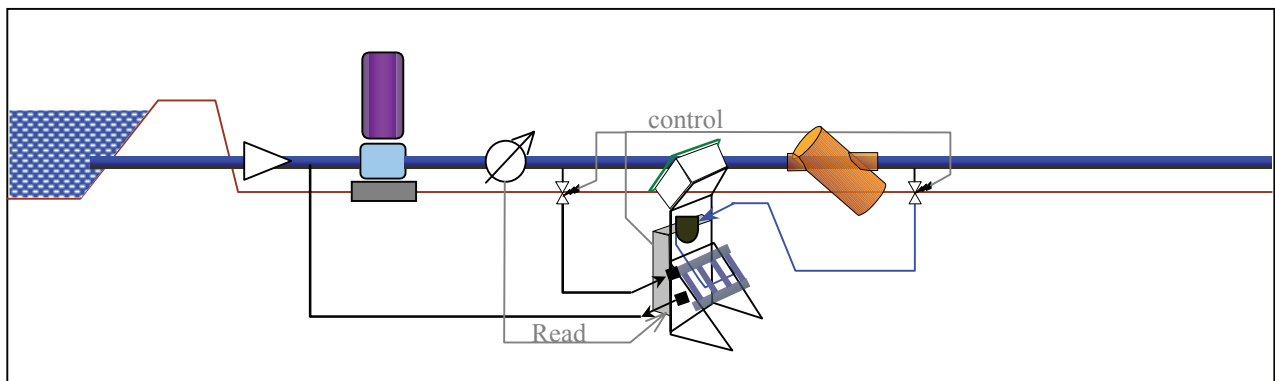


Figure 4: HP Non-Driven

Procedure

- (1) Unpack the Fertijet and rest it on a solid base. Mount the I/O box on a solid wall or post.
- (2) Connect the 32mm inlet and outlet pipes to the mainline as shown above.
- (3) Connect the blue pipe (water sampling for EC and pH sensor measurements) to the main irrigation line at a point at least 1.5m (4 feet) downstream from Fertijet's outlet connection. Note that the exact recommended distance depends on the water flow speed in the main pipe. For more accurate calculation, use your Internet browser to refer to the URL: ftp://ftp.eldarshany.com/pub/literature/fert_calc.xls
- (4) Open the EC-pH sampling cup and remove the pH sensor cover. Fill the sampling cup with water and mount it back in place.
Important: The pH sensor must be immersed in water at all times.

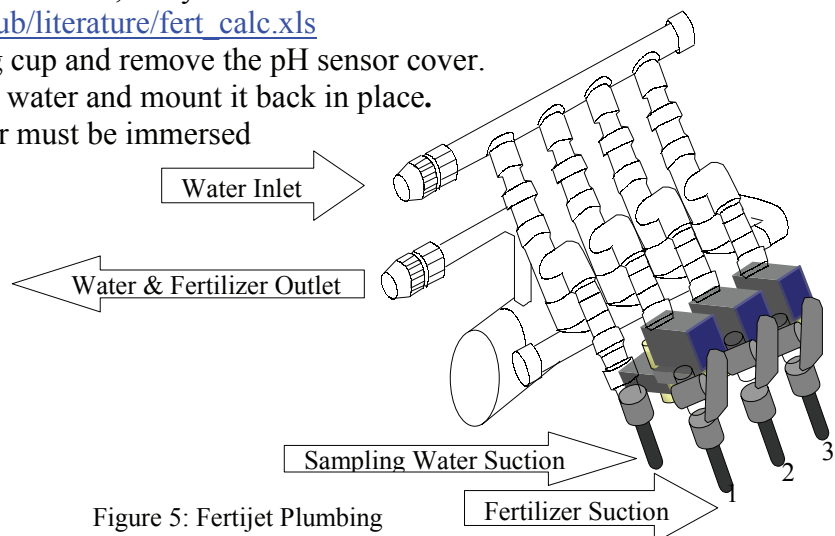


Figure 5: Fertijet Plumbing

- (5) Connect the pipes from the fertilizer tanks to the fertilizer injector inlets: Fertijet default settings define Injectors #1 and #2 as nutrients injectors (EC injectors allowing correction of quantities according to conductivity) and Injector #3 as an acid injector (pH injector attempting to maintain pH stability). For a different configuration (e.g. two acid injectors and one fertilizer), change the settings in menu screen no. 5216.

2.2 Wiring

Power Supply Connections

- (1) **Booster pump power connection:**
Have a local, qualified electrician connect the booster pump load according to the marking sticker at the end of the HD (green) cable.
- (2) **Controller and communication connection:**
Plug the controller and communication (white) cable to the local mains using a connection box (not a wall socket!). Verify that this power point is protected by a 6A circuit breaker.

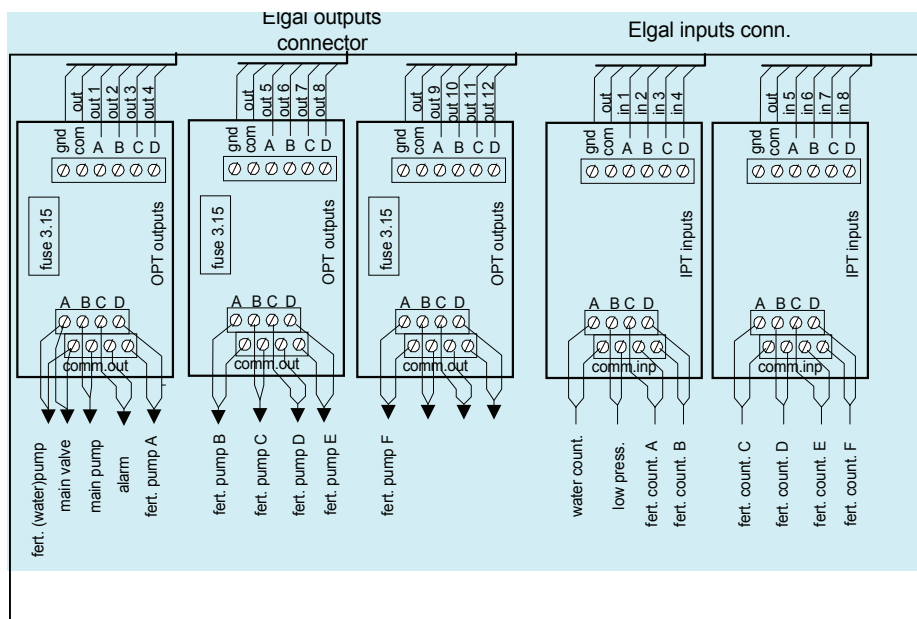


Figure 6: Input/Output Connections

Output Connections

- (1) Verify that all field valves as well as the main valve, main pump, filters flushing and any other such elements are all 24V AC operated, with a maximum rating of 5W.
- (2) Open the I/O box cover and identify the OPTN cards. Notice the numbers marked on the cards: these are output numbers left free for your own use after applying the Fertijet's accessories (injectors valves, booster pump). Connect your devices to the free points and record your connections on ID Book page 4.
Attention: The default settings allocate Output 1 for the main valve and output 2 for the main pump. To change these settings, e.g. for the sake of standardization, see ID Book page 4 (right column).

- (3) Set the controller as required to acknowledge your connections. To set, follow instructions as applicable to the program used (see table below):

Fetijet with 1CL_IR Software (Elgal 12/24)	Fertijet with Open Field Software (Elgal 2000/Midi)
Follow the instructions in the “Elgal Setup” manual, Chapter 2, to define and allocate your outputs according to your previous ID Book listings.	Follow the instructions in the “Elgal Agro” operation manual, page D25 (code 751,) to define and allocate your outputs according to your previous ID Book listings.

Should you need any help navigating in the Elgal menu – read “Basics” (Chapter 1) in the Elgal manual.

- (4) Check menu 4 (Alarms) for a possible double- output alarm. The controller will invoke such alarm in the event of inadvertent use of the same output for two different devices.

Discrete Inputs Connections

- (1) Verify that the water meter, rain pulse sensor, motor fault switch and any other such elements are all of a dry- contact type. The controller will supply 12-24V DC to one of the contact polls and will track a change in contact status.
- (2) Identify the IPT terminal cards in the I/O box. Notice the numbers marked on the cards: these are the input numbers left free for your own use after applying the Fertijet’s accessories (booster pump overload trip, low pressure switch). Connect your own devices to the free points and record your connections on ID Book page 6.
Attention: The default settings allocate Input 1 for the water meter pulse. To change these settings, e.g. for the sake of standardization, see ID Book page 6 (right column).
- (3) Set the controller as required to acknowledge your connections. Should you need any help navigating in the Elgal menu – read “Basics” (Chapter 1) in the Elgal manual. To set, follow instructions as applicable to the program used (see table below):

Fetijet with 1CL_IR Software (Elgal 12/24)	Fertijet with Open Field Software (Elgal 2000/Midi)
Follow the instructions in the “Elgal Setup” manual, Chapter 2, to define and allocate your inputs according to your previous ID Book listings.	Follow the instructions in the “Elgal Agro” operation manual, page D25 (code 752,) to define and allocate your inputs according to your previous ID Book listings.

2.3 Low Pressure Switch

The Fertijet features a low pressure (LP) switch to prevent pump operation under a low water pressure. The LP switch is initially adjusted to 35 PSI. To change, follow the instructions below. **WARNING!** Reducing the value below 25 PSI will endanger your booster pump and void our warrantee immediately!

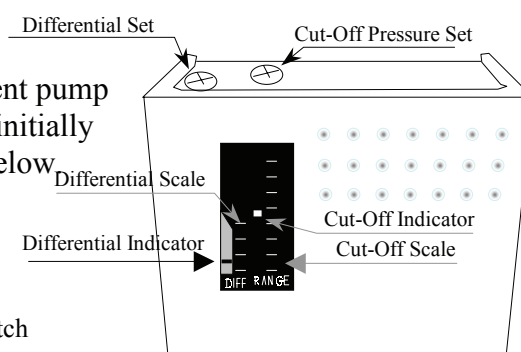


Figure 7: LP Switch

To change LP switch settings, remove the black cover to expose two screws at the top of the unit. Use only that screw which is closest to the back line. To reduce the pressure, turn the screw clockwise (you will see a metal line move up on the scale). To increase the pressure, turn the screw counterclockwise.

2.4 EC-pH Sampling Cell Pressure

The pH probe provided is a low pressure probe. Never expose it to a pressure higher than 50 PSI. To adjust cell pressure, first verify that the main line is pressurized and the Fertijet's booster pump is running. To adjust, follow this procedure:

- (1) Close the manual valve at the blue sampling pipe inlet.
- (2) Remove one of the probes from the cell's top.
- (3) Open the manual valve gradually until the water slightly overflows from the empty hole.
- (4) Re-fit the probe in place and fasten its gland.
- (5) Recommendation: Remove manual valve's handle to prevent inadvertent readjustment.

Kg/cm ²	Bar	PSI
1	0.98	14.22
2	1.96	28.44
3	2.94	42.67
4	3.92	56.89
5	4.90	71.11
6	5.88	85.34

3. Irrigation System Setup

Each system is uniquely characterized by own water meter pulse, valve flow rates, fertilizer types and settings. All of these parameters are necessary for system operation and must be programmed on the site before the first operation. To set system parameters, follow instructions as applicable to the program used (see table below):

Fertijet with 1CL_IR Software (Elgal 12/24)	Fertijet with Open Field Software (Elgal 2000/Midi)
Follow the instructions on "Irrigation software" manual page I2-1 and top of page I2-2. Fertijet may be used either as a "standard" system when applied to the entire irrigation system or as "Fert-Only" system when applied to the fertigation system alone.	Follow the instructions on "Elgal Agro" manual pages D20 (code 45) and D23 (code 72).

On completion, both the controller and the irrigation system are ready for operation.

4. Operation

4.1 Using the Irrigation Program

To operate the system, follow instructions as applicable to the program used (see table below):

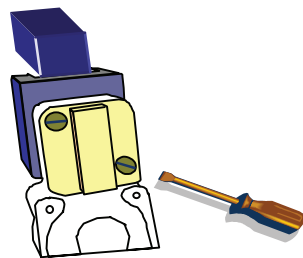
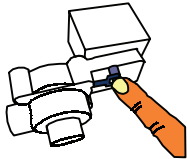
Fetijet with 1CL_IR Software (Elgal 12/24)	Fertijet with Open Field Software (Elgal 2000/Galileo)
Follow "Irrigation Software" manual instructions on the daily use of the irrigation program.	Follow "Elgal-Agro" manual instructions on the daily use of the irrigation program.

4.2 Fertilizer Injectors Adjustment

Every fertilizer injector must be flow- adjusted to some extent. To adjust, use one of three methods as listed below:

- Fixed cone-jets of 20, 40, 60 and 80 liter/hour (5, 10, 15 and 20 GPM).
- Flow- control valve.
- Flow indicator with control valve.

Follow the instructions in the table below as applicable to the method selected for each injector:

Step	Cone-jet	Adjustable valve	Flow indicator
1	Establish optimal pump flow to inject during 40-70% of the irrigation time, taking into consideration the specific mainline flow, fertilizer concentration and final quantity of nutrient required. Consult ftp://ftp.eldarshany.com/pub/literature/Fert_Calc.xls ("Fert Calc" sheet) as required. 		
2	Fit jet in housing	Remove bottom cover of fertilizer solenoid valve by unscrewing the 2 flat bolts.	
3		Immerse the far end of the flexible pipe in a measurable bucket of water. Start the irrigation program. 	Immerse the far end of the flexible pipe in a bucket of water. Start the irrigation program.

4		Press the solenoid's plunger up with your finger for exactly 30 seconds.	Press the solenoid's plunger up with your finger and set the required flow on the scale.
5		Measure the amount of water pumped out of the bucket. Calculate the flow by multiplying the quantity of the missing water by 120.	Fit the plunger protector back in place and secure with bolts.
6		Adjust the valve slightly. Repeat steps 4-5 until the required flow is obtained. Fit the plunger protector back in place and secure with bolts.	
7	Update the "Fertilizer pump flow" parameter in the controller: code <5216 #3> in CL_IR 2.04 or code <452 #3>		

4.3 Fertigation Automation Adjustment

This chapter is intended to clarify some special features of Fertijet, which are not explained in the Elgal manual. Please read the complete irrigation chapter in the Elgal manual to better understand the fertigation method of the Elgal controller.

Description

Fertijet does not pre-set the point where the EC-pH sample is taken. This decision is left to the technician who installs the machine. This point and the length of the pipe to the sampling cell both have a considerable effect on the fertilizer automation function. When the program changes the water-to-fertilizer ratio, a timer is set to define the minimum time to the next change (if required). This function serves to identify the impact of the last change as soon as possible, then make the next change. Performing the second change before reading the results of the first one would cause overshooting, and the EC and pH may never become balanced. On the other hand, a slow reaction is not desirable either.

Calculating the shortest response time is not an easy task. If you have Internet access, you can find an on-line calculator for that purpose at:

ftp://ftp.eldarshany.com/pub/literature/Fert_Calc.xls ("Fertijet balancer" sheet). All you have to do is type your application details in the appropriate cells, and the calculator will come on with the results.

If you do not have access to the Internet, use this formula:

$$Rt = ht + dt + Dt + 3$$

where:

SQ – the flow of the smallest shift in the irrigation system

D – the internal diameter of the main pipe

Dl – the distance between the fertilizer insertion point and the sampling outlet in the main pipe (cm)

Dt – the delay time in the main pipe; $Dt = (((D / 2)^2 * \pi) * Dl) / SQ$

dl – the length of the 32mm pipe from the Fertijet outlet to the main pipe (m)

dt – the time in the 32mm pipe (sec); $dt = dl / 13.9$

hl – the length of blue sampling hose (m); $ht = hl / 0.4$

ht – the time in blue sampling hose (sec)

Rt – the response time required

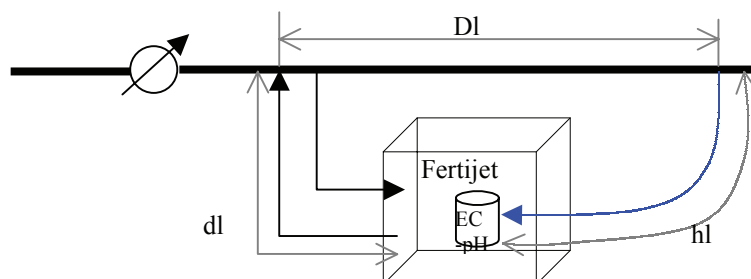


Figure 8: Rt Calculation

Notes

- Calculation as above may be problematic since different units are used in different countries.
- The last 3 seconds added to the calculation represent probe's response time.
- "dl" is subject to many changes as may be caused by line pressure, pump model (MXH 405 or 805), number and type of Venturi pumps, and even fertilizer valves position (on or off). However, as you will find when you do the calculation, as long as you do not install the Fertijet at a distance greater than one or two meters from the insertion point, the effect on the calculation would be negligible.

Procedure

- (1) Calculate shortest response time (Rt) as above.
- (2) Save calculation result under the respective parameter in the controller. To save, press <5241> and <R> on the controller panel or (for PC users) click <settings>, <Irrigation>, <Fertigation setup>.
The text displayed on the panel will be "Change fert. Delay – sec.", with a default value 8. Enter calculation result, then press <Enter>.
- (3) Move to the next parameter. The text displayed will be "Delay at start – sec.", with a recommended value two and a half times the change delay. Press <Exit>.
- (4) You will now be prompted to save the last changes. Press <Enter> to confirm the default setting, or, if you use a PC, click the key icon and change the desired parameters.
A second click on the key icon will send your changes to the controller after confirmation.

5. Maintenance

5.1 Fertijet Maintenance Board

Component	Action	One month after first operation	Weekly	Monthly	End of Season
Electrical connections	Shut off main power switch and fasten all screws securely.	X			
Fertilizer tank filters	Clean.		X		
Booster pump	Run with fresh water for 5 minutes, then bleed all water out.				X
Fertilizer solenoids (Sirai)	Wash crystallized minerals. Lubricate plunger with silicon oil.			X	
Fertilizer Venturi injectors	Adjust flow, clean possibly clogged jets.			X	
EC-pH 3050	Calibrate probes.			X	

X – to be performed by a local, authorized electrician.

5.2 Winterizing

Winter time in frost- ridden areas may prove quite harmful to all irrigation components if not duly prepared. The following steps will guide you in safe winterizing. Follow them strictly.

When to Winterize

The best time to winterize is the morning after the last day of the irrigation season.

Procedure

- (1) Wash out all corrosive material residues. Fill the fertilizer tanks with fresh water (if you have some fertilizer left for next season, fill a bucket with water and place it instead of the tank), then run the system with a program that will use all the injectors. Ensure that each injector receives at least 20 liters (4 gallons) of water.
- (2) Close all manual valves and turn all pumps switches Off. Define the Elgal controller “Not active”.
- (3) Disconnect Fertijet’s inlet and outlet pipes from the main pipe and tip over to drain of all contents.
- (4) Dismantle all records and bleed all water residues from the Venturi injectors, electrical valves, check valves and other elements as required.
- (5) In applications employing main fertilizer NC valves, make sure to dry all the 8mm command hoses, the solenoid valve, and both the upper and lower chambers of each valve.
- (6) Open the booster pump’s draining cap (Figure 9) and leave it opened for 1 hour.
- (7) Verify bleeding of all pipes.
- (8) Remove one of the probes from the EC-pH sampling cell and drip in 50cc (2 OZ) of concentrated antifreeze material. Re- fit the probe in place and secure with bolt.

- (9) Clean the Fertijet of all external residues of corrosive materials. Cover the Fertijet with a sheet. **Do not shut controller's power supply down!** – leaving the Elgal controller powered down for an extended period of time may drain the memory backup lithium battery.

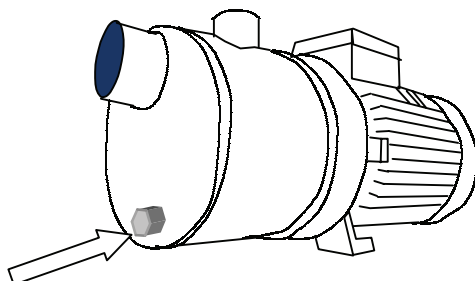
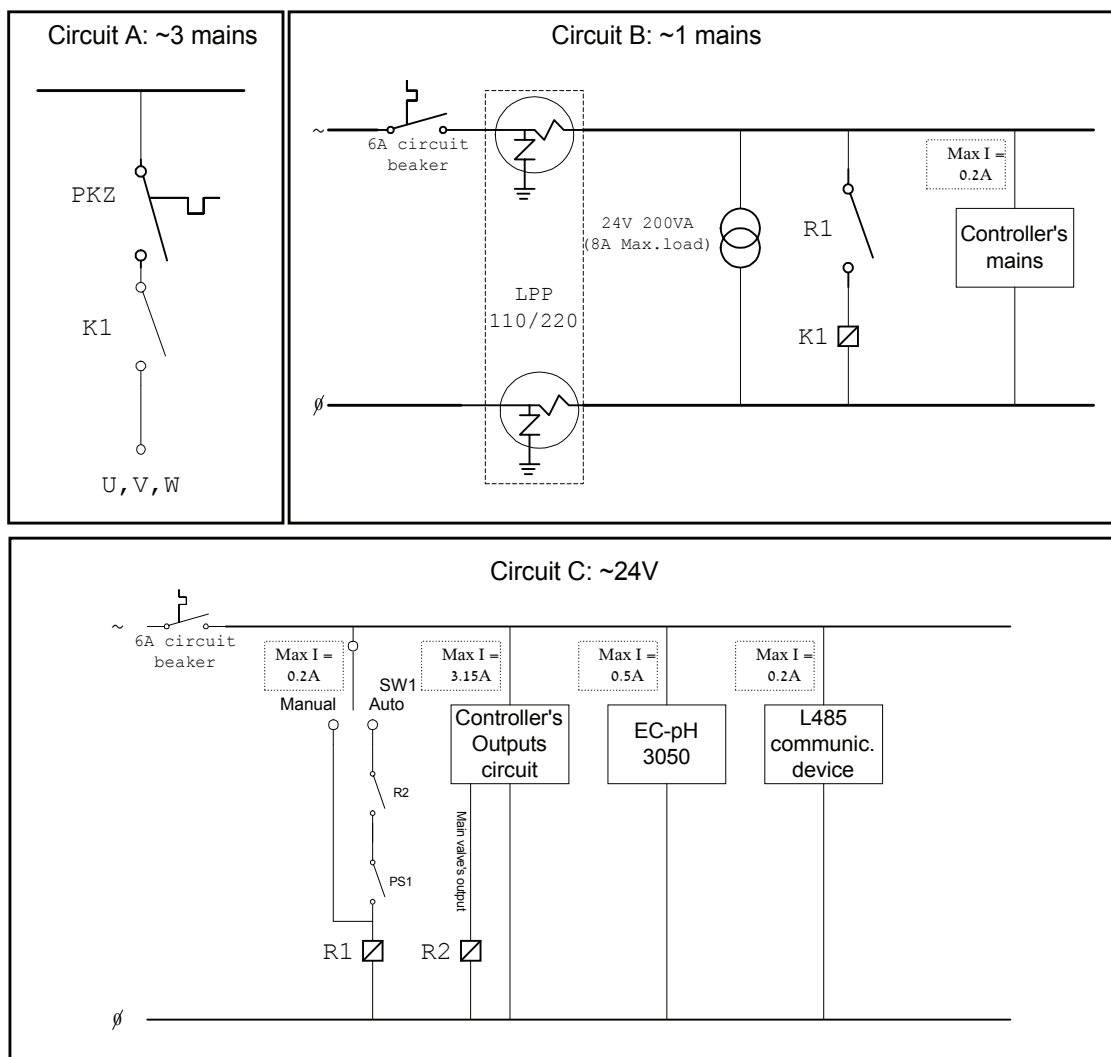


Figure 9: Booster Pump Draining Cap

Appendix 1 - Electric Drawings

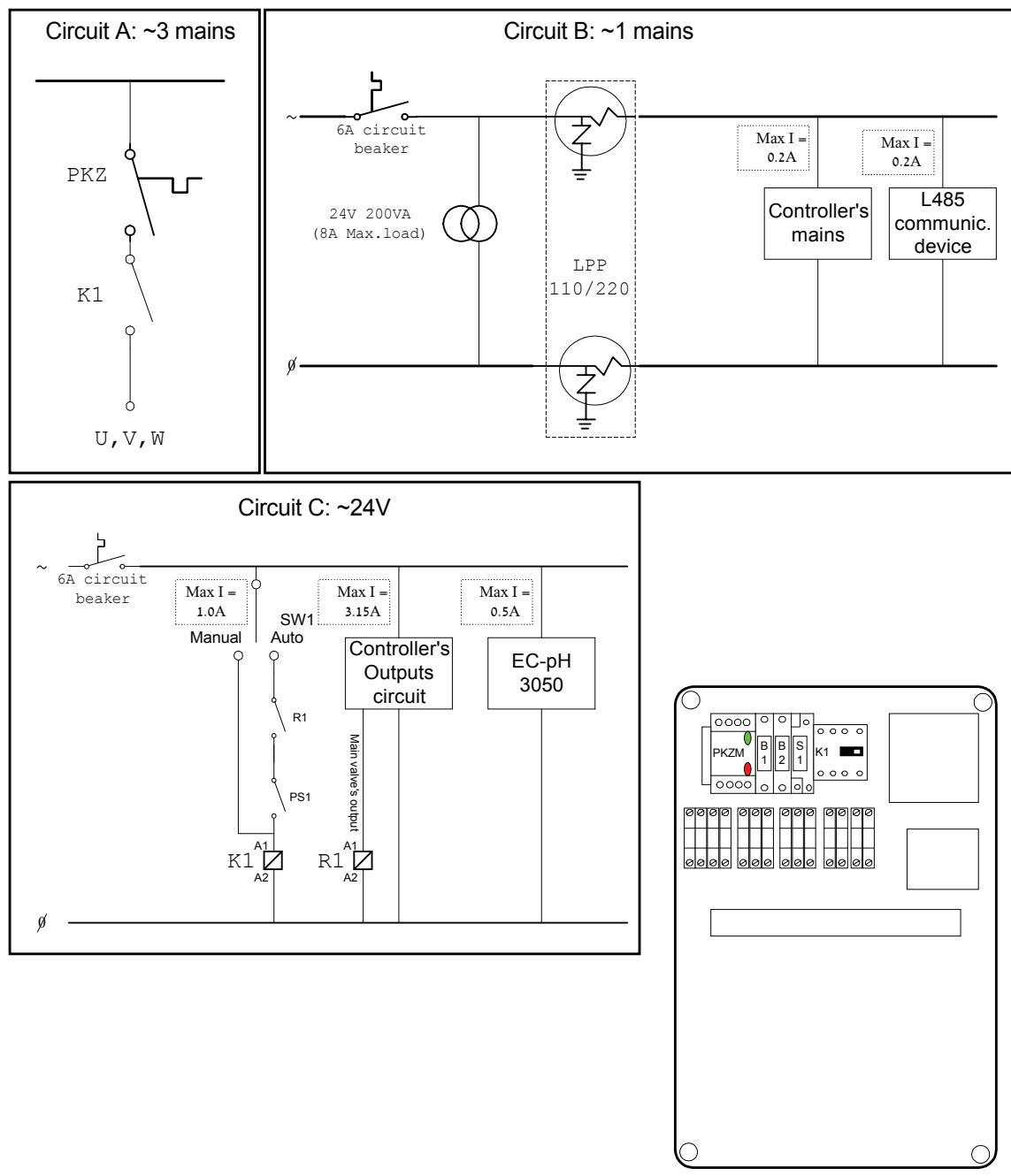
FertJet Electrical diagram

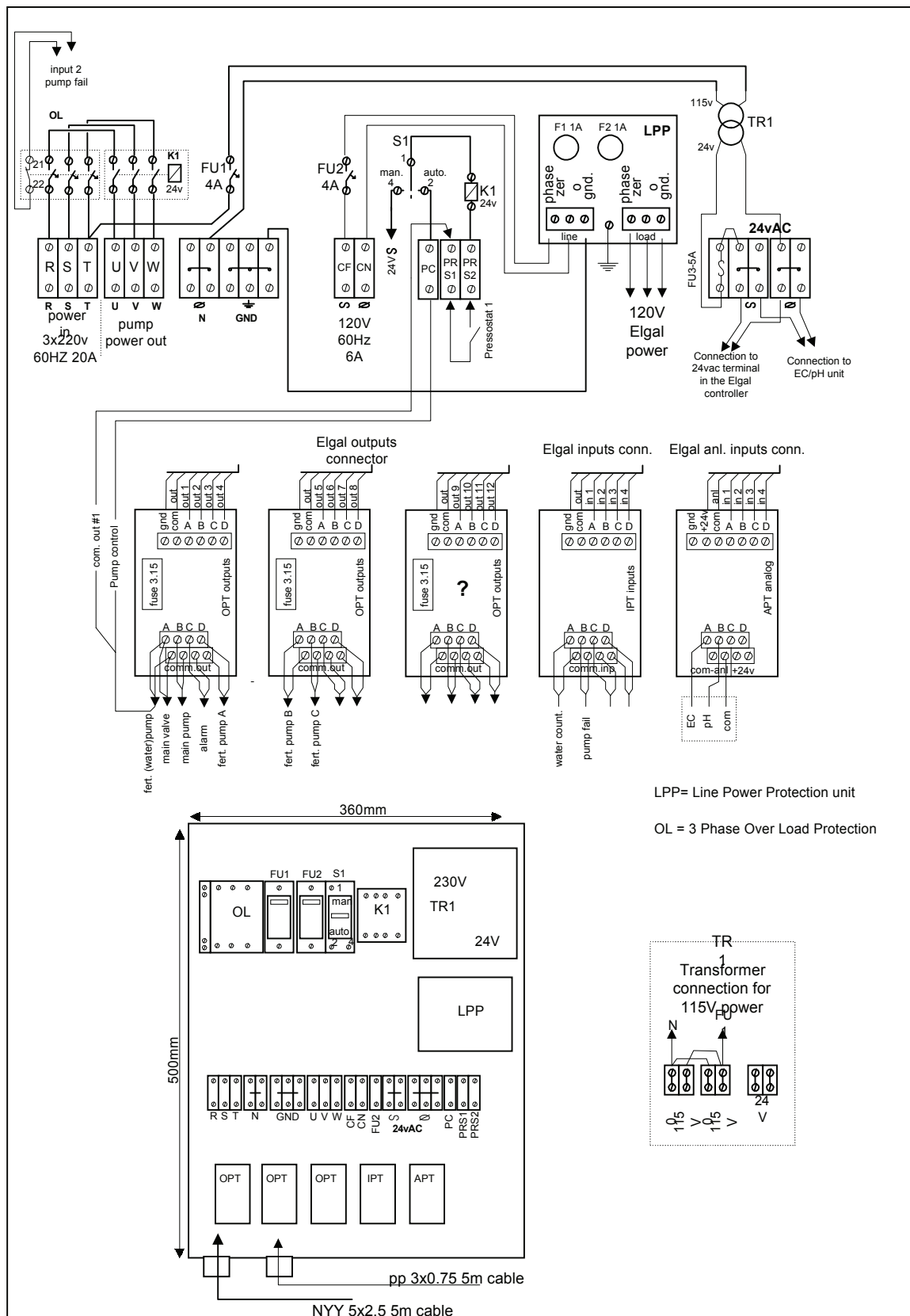
for systems with ~3 booster pump



FertiJet Electrical diagramme

for systems with ~3 booster pump



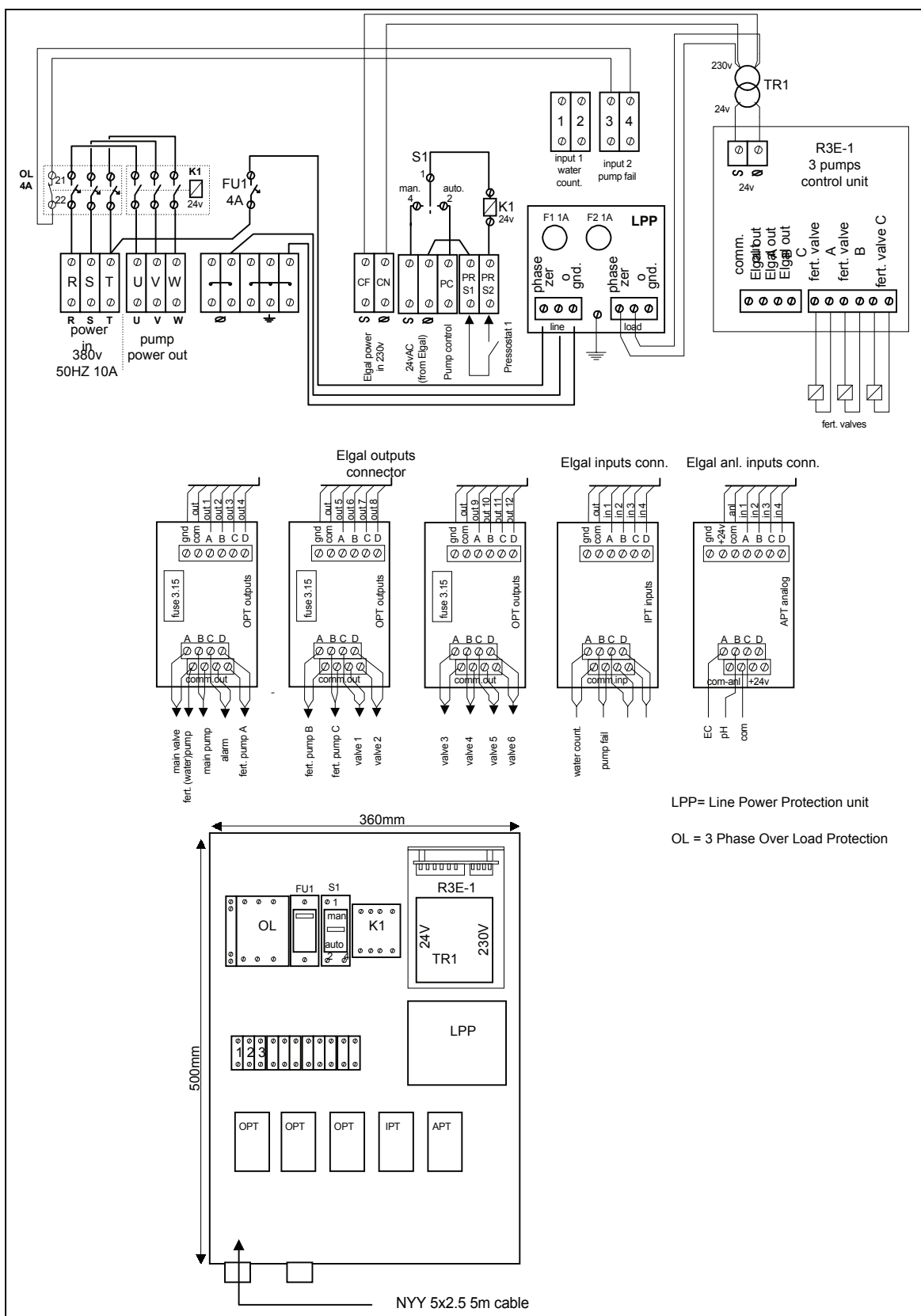


LPP= Line Power Protection unit

OL = 3 Phase Over Load Protection

Fertijet - 3 Booster Pump

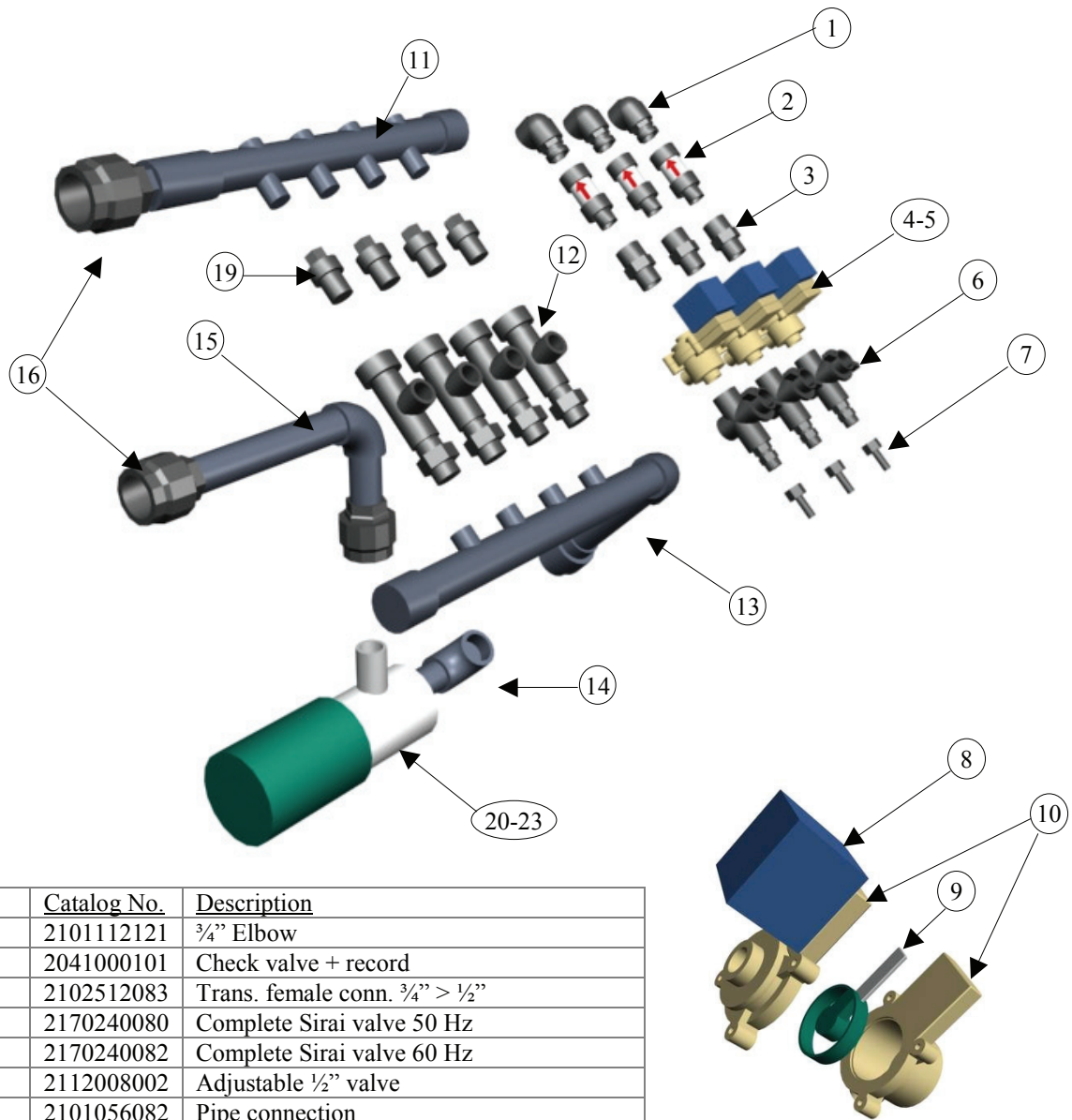
Electric Panel



Compact Fertigal

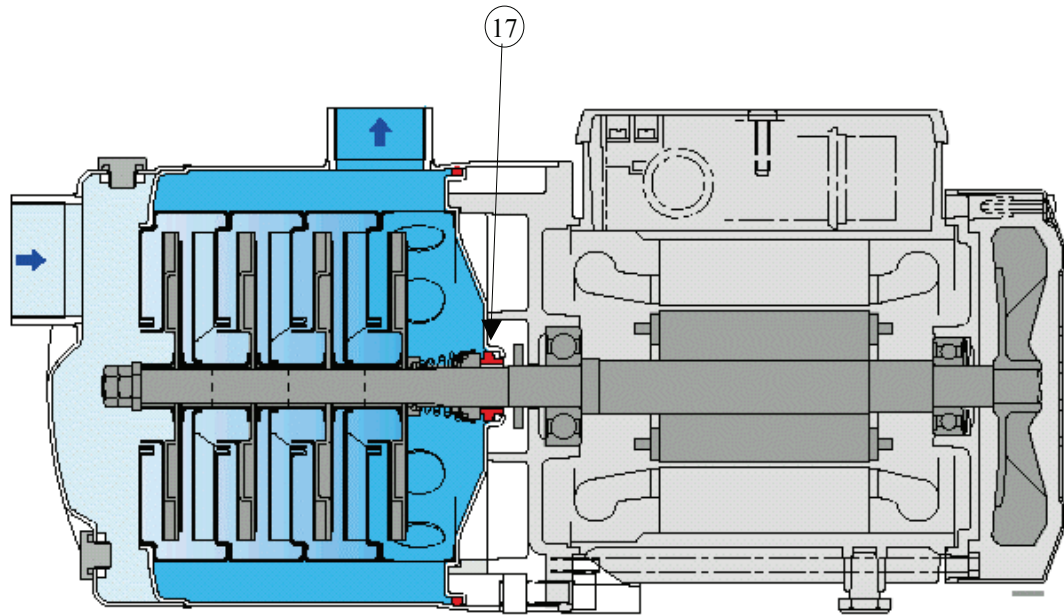
Electric Panel

Appendix B – Mechanical Drawings



No.	Catalog No.	Description
1	2101112121	3/4" Elbow
2	2041000101	Check valve + record
3	2102512083	Trans. female conn. 3/4" x 1/2"
4	2170240080	Complete Sirai valve 50 Hz
5	2170240082	Complete Sirai valve 60 Hz
6	2112008002	Adjustable 1/2" valve
7	2101056082	Pipe connection
8	2171002415	Sirai coil ~24V 50 Hz
8	2171002416	Sirai coil ~24V 60 Hz
9	2171910120	Diaphragm (New)
9	2171910110	Diaphragm (Old)
10	2171002420	Sirai valve housing
11	01120010	Distributor manifold 4 outlets
12	0910311000	Venturi injector skeleton 350 l/h (90 GPH)
13	01120005	Mixing manifold 4 inlets
14	01120100	Booster pump inlet adaptor (800 series)
14a	01120105	Booster pump inlet adaptor (400 series)
15	01120110	Water + fertilizer outlet fitting (800 series)
15a	01120115	Water + fertilizer outlet fitting (400 series)
16	2301732161	Flexible pipe fitting 32mm x 1 1/2"
17	2010500020	Mechanical bearing 16mm

Features



20	2010006405	Booster pump ~3 400V	50 Hz 1.5 HP
21	2010006805	Booster pump ~3 400V	50 Hz 2.5 HP
22	2010006403	Booster pump ~3 400/220V	60 Hz 1.5 HP
23	2010006802	Booster pump ~1 120V	60 Hz 2.0 HP
24	2010006803	Booster pump ~3 400/220V	60 Hz 2.5 HP

Appendix C – Performance Specifications

Table C-1: Injector Combinations (EC-pH injector calculated but not counted)

Comb. No.	350 l/h (90 GPH) type	1020 l/h (300 GPH) Type	Total Booster Q L/h (GPM)	Nutrients Injection Capacity	Acid IA
1	2	0	3000-4000 (13-18)	350 l/h	350
2	3	0	4500-5500 (20-24)	700 l/h	350
3	4	0	5600-7000 (25-30)	1050 l/h	350
4	5	0	6700-8500 (30-37)	1,400 l/h	350
5	1	1	6500-7900 (29-35)	1,050 l/h	350
6	2	1	7400-9100 (33-40)	1,400 l/h	350
7	1	2	10400-12800 (45-56)	2,100 l/h	350
8	1	3	14500-18000 (64-80)	3,150 l/h	350
9	0	4	18000-22000 (80-97)	3,150 l/h	1020

Table C-2: Pumps vs. Downstream Pressure – Valid Combinations

Downstream Pressure	1.5 HP	2.5-3 HP	7.5 HP
2.5 bar	2,3,4	N/A	N/A
3 bar	2,3	3-7	N/A
4 bar	1,2	2-6	9
5 bar	1	1,2,3,5	8,9

The injection rate represents maximum injection capacity, with mainline flow rate as a factor. Using two injectors to inject a higher rate of fertilizer is common whenever necessary, therefore the chart below simply represents the total injection capacity of each combination.

